available (at least within the limits observed), according to our author, while the reverse is true in the other species just mentioned. Mr. Long might profitably have referred to Dr. Spence's experiments on *Hevea* in connection with his discussion of the functions of latex, about which we are indeed, as he states, very much in the dark.

No less important practically is the question of the nature of coagulation, and here also from now on careful scientific methods must be employed if further material progress is to be made.

Mr. Long's book indicates these and numerous other problems which await the attention of both planter and scientist, and because of this and because it contains a summary of practical results in plantation methods and management thus far obtained stated by an evidently careful student of practical methods, it will be worth study by every one interested. Tables of approximate costs and of data derived from tapping experiments based upon his actual experience in the east are given and the value of these is beyond question as offering guidance to those concerned.

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THE WORK OF THE U. S. FISHERIES MARINE BIOLOGICAL STATION AT BEAUFORT, N. C., DURING 1913

THE laboratory of the Bureau of Fisheries at Beaufort, North Carolina, was opened to investigators engaged in the scientific and economic problems of the Bureau and to independent workers on June 9, and closed about the middle of September. The number assigned to the laboratory taxed its capacity and not all applicants could be accommodated. Following is a brief summary of the summer's work and of the various activities of the station during the year.

The equipment of the station was enhanced by the addition of beam trawls, a small fish trawl, stow-net, new pound-net, three new rowboats, a photomicrographic outfit, and numerous other articles needed in the laboratory, power house and mess house. The most important addition was that of a 33-foot motor boat equipped with a 24 horse power 4-cycle 4-cylinder Lamb engine. This boat has a 10-foot saloon with suitable accommodations for extended trips and a large after deck, convenient for landing the beam trawls, boat dredges and fish trawls used at the station. It is a one-man control boat and is especially adapted to the needs of the laboratory. A new dark room for photographic work was built in one end of the laboratory. This replaced the one on the museum floor and added greatly to the conveniences of the laboratory.

The success attendent on the propagation of the diamond-back terrapin at this station has attracted considerable attention and a number of persons are contemplating engaging in this industry. Early in the year a company was formed at Beaufort and plans were perfected for growing terrapin for market on a large scale. The company has a well-equipped establishment with over 3,000 terrapin purchased for breeding purposes. The adaptability of this form to artificial conditions was shown by the fact that terrapin purchased during the laying season continued their activities in captivity and before the close of the season over 700 young terrapin had been added to the company's stock.

The 1913 brood of the laboratory numbered 1,424 on November 10. This is an increase of 198 over the brood of the preceding year. The average number of eggs per terrapin has steadily increased with longer periods of confinement. Those purchased in the early stages of the experiment, this year averaged over 13 eggs apiece. It was also quite evident from the number of eggs per nest that the terrapin in this pound laid twice during the season. In October, 554 terrapin belonging to the broods of 1911 and 1912 were planted in suitable localities in Lynnhaven Bay, Va., and 200 of the 1912 brood were sent to Chase, Florida, for experimental purposes. A brief account of the cultural experiments with this species by W. P. Hay and H. D. Aller is contained in Economic Circular No. 5 of the Bureau of Fisheries issued June 24, 1913, and entitled "Arti-

ficial Propagation of the Diamond-back Terrapin."

Following the plan outlined in 1912, special emphasis was laid on the collection of data on the fishes of the region. The date of spawning of the southern flounder (*Paralichthys lethostigmus*) was determined. As the flounder fishery is an important one and as the various edible species are less abundant than formerly, steps are being taken to engage in their propagation at this station. The opportunities for engaging in propagation work have been advanced by the addition of the position of fish-culturist, and Mr. Charles Hatsel, who showed a great deal of natural ability in carrying out the cultural experiments with the diamond-back terrapin, fills this position.

For the purpose of determining the location, extent and resources of the off-shore fishing grounds and to encourage their development, the Fisheries Steamer *Fish Hawk* was detailed to the laboratory for a period of two months, and on September 6 began a brief survey. A number of grounds where blackfish or sea bass (*Centropristes striatus*) were abundant were surveyed and charted, and representative collections of the local fauna were made. The success attendant on line fishing by members of the *Fish Hawk's* crew and of fishermen visiting these grounds are encouraging, and more than 15,000 pounds of this fish were taken. A brief summary of the results of this work is contained in Economic Circular No. 8, of the Bureau of Fisheries, issued February 25, 1914, and entitled "The Offshore Fishing Grounds of North Carolina."

The following species taken in the Beaufort region during the year are believed to be new records for the coast of North Carolina:

Anchovia argyrophana (Cuvier & Valenciennes),
Anchovia perfasciata (Poey),
Aprionodon isodon (Müller & Henle),
Blennius stearnsi Jordan & Gilbert (?),
Calamus calamus (Cuvier & Valenciennes),
Callionymus calliurus Eigenmann & Eigenmann,
Congermuræna balearica (De la Roche),
Clupea hanengus Linnæus,
Hemicaranx amblyrhynchus (Cuvier & Valenciennes),
Ioglossus calliurus Bean,
Letharchus velifer Goode & Bean,
Ogcocephalus radiatus (Mitchell),
Pagrus pagrus (Linnæus),
Parexocœtus mesogaster (Bloch),
Platophrys ocellatus (Agassiz),
Rhomboplites aurorubens (Cuvier & Valenciennes),
Rypticus bistrispinus (Mitchill),
Syacium micrurum Ranzani,
Vulpecula marina Valmont.

A report on the sharks and rays of the Beaufort region, in which special stress is laid on the character of the teeth and dermal denticles as an aid to identification, is being prepared by the director.

The scientific workers at the laboratory have furnished the data on which the following brief summary of their work is based:

Dr. C. H. Edmondson, of Washburn College, devoted six weeks to a survey of the marine protozoan fauna in the vicinity of Beaufort. This work was conducted along three more or less closely connected lines, as follows:

1. Study of pelagic forms obtained by means of tow nets and the stow net. The latter was used to good advantage in collecting the free-swimming surface forms.

2. Dredgings taken in the vicinity of the sea-buoy on a bottom of thick black mud in 5 or 6 fathoms of water. This proved to be very rich in Foraminifera.

3. Examination of the contents of the stomachs of a number of species of fishes with a view of determining whether or not certain marine protozoa might be considered as constituting a portion of the food of these fishes.

The similarity of the protozoan fauna of the Beaufort region in many of its features to that found in such widely separated localities as Woods Hole, Mass., the Dry Tortugas, the Pacific Ocean off the coast of southern California and even in the Puget Sound region, was striking.

Of the fishes examined for their stomach contents, only three species showed evidences

of having ingested protozoa. Many species of protozoa were always found in the stomachs of the hairy-back or thread herring (*Opisthonema oglinum*) and the menhaden (*Brevoortia tyrannus*). *Dinoflagellates* were commonly present in the stomachs of these species, and several species of *Ceratium* and *Peridinium* were always present, while *Dinophysis* was nearly as constant.

Tintinnopsis, a ciliate, represented by at least three species, was always present in the menhaden, frequently in myriads. The pinfish (*Lagodon rhomboides*), also a surface feeder, ingests masses of algæ and probably protozoa, but only rarely were evidences of the latter found. Broken fragments of *Ceratium* were occasionally present in its stomach. The coarse gill-rakers of this fish probably permit the minute organisms to escape.

Tunicates were also examined and the ciliate, *Tintinnopsis,* was almost universally found in the digestive cavities and may be considered one of the items of food of these forms.

A more extensive study of this phase of the problem would undoubtedly verify the belief that the protozoa are of very high economic value as food, either directly or indirectly, for many fishes as well as other marine forms.

Mr. W. C. George, of the University of North Carolina, an independent worker, devoted considerable time to a general study of the local fauna and in studying early stages in the embryology of *Chætopterus* and the reduction phenomena exhibited in the medusæ of *Pennaria.*

Professor W. P. Hay, of Washington, D. C., continued the investigation of the diamond-back terrapin and gathered additional data for a final report in which, it is hoped, a complete account of the life history of this animal can be given. Observations were made on the rate of growth of the loggerhead turtle. Two of the young ones hatched at the laboratory in September, 1912, survived the winter and attained the age of one year in captivity. During this time these increased in length from about 77.3 mm. to 200 and 218 mm. respectively.

Rather late in the season an investigation of the blue crab was begun, to determine rate of growth and interval between moults. From the results obtained it appears that the species casts its shell with fair regularity about every two weeks and increases in measurement about one quarter to two fifths at each moult up to maturity. After sexual maturity has been attained moulting probably ceases and the animals, especially the females, fall easy victims to various parasites. It was not possible to secure positive evidence that the females lay a second lot of eggs, though it is probable that those which survive the winter do so.

Aside from the experimental lines of work considerable time was devoted to collecting, identifying and describing the decapod crustaceans of the region. A paper embodying the results of this work is being prepared.

Mr. Selig Hecht, of the College of the City of New York, who was assigned to the director for duty, accompanied certain of the collecting trips and engaged in (1) a preliminary study of the rate of growth of the menhaden; (2) the relation of form, weight, length and other body measurements for the following species: *Anchovia brownii, Anchovia mitchilli, Brevoortia tyrannus, Leiostomus xanthurus, Peprilus alepidotus* and *Orthopristis chrysopterus.* In all cases there was a clear correlation between weight and length, so that weight was shown to be a cubic function of length. The interrelationships of the various parts of the body and total length were established for each species. It was found for each that the form of the fish remained constant throughout the life of the individual, and correlated with this that the volume of the fish was a function of the product of the length, width and depth, as well as a function of the weight. These combined relationships mean that weight in these species is equal to the product of length, width and depth times a constant which differs for each species.

The relative growth of various parts of the fish was studied, and the results show that although apparently the various parts of the fish grow at different constant rates relative to the

total length, their absolute rates of growth are the same. This apparent rate of growth of each part relative to the total length is a function of the ratio of the length of the part to the total length of the fish. (3) Study of the puffing mechanism of *Spheroides maculatus*. Anatomically the mechanism is composed of two parts: a diverticular bag from the ventral wall of the esophagus, and several sphincter muscles. In inflation with water, the liquid is drawn in as in a normal inspiration. During the expiration, however, all openings to the exterior are shut and the muscle controlling the opening into the esophagus, and eventually into the diverticular bag is released and the water is forced into the diverticulum or "puff-bag." This occurs several times before inflation is complete. Inflation with air differs from that of water in that during inspiration the air is drawn into the oral cavity largely through the opercular openings and not through the mouth.

Dr. Albert Kuntz, of the University of Iowa, continued the investigation of pelagic fish eggs and larvæ. This work was undertaken for the purpose of securing a record as complete as possible of the time of spawning and of the embryological and larval development of fishes with pelagic eggs breeding in these waters during the summer, one of the primary objects being to afford a ready means of identifying either eggs or larval fishes at any time during embryological and larval life.

Pelagic eggs and larvæ of not less than eight species were taken during the summer. Complete records of the embryological and larval development of two species, viz., *Bairdiella chrysura* (Lacépède) and *Anchovia mitchilli* (Cuvier & Valenciennes) were secured. Observations on the eggs and larvæ of the remaining species as yet remain incomplete.

Dr. S. O. Mast, of Johns Hopkins University, devoted his time to a study of the changes in pattern and color in fishes, especially the flounders. The flounders lie on the bottom most of the time and the skin assumes a color and pattern so nearly like that of the environment that it is frequently very difficult to see them. On a black bottom they become black; on a white bottom, white; on a yellow bottom, yellow; on a blue bottom, bluish; on a red bottom, reddish, etc. All of these changes in the skin are regulated through the eye. This indicates color vision. If the bottom is finely mottled, the pattern on the skin assumes a fine grain; if coarsely mottled, it assumes a coarse grain; but there is no evidence indicating an actual reproduction of the configuration of the background.

If, after the skin has become adapted to a given bottom, the fish are removed to a different bottom, they tend to return to the original, *i. e.*, they tend to select a bottom which harmonizes with their skin. A large number of photographs and autochromes were made to facilitate this study and to serve in illustrating the report.

Mr. L. F. Shackell, of St. Louis University school of medicine, continued work begun in the summer of 1912 on the protection of wood against the attacks of marine borers. The test employed on the pieces of wood treated at that time—submersion in the water of Beaufort Harbor for ten months—eliminated many forms of treatment. The work of the past summer, therefore, consisted of detailed experimental work involving a very few materials found to be effective over a relatively short period. The cost of treatment was also considered in the later work. It is not expected that definite results of any economic importance will be obtained in less than three years' time, during which the present series of treated pine poles will be continually submerged under sea water.

Mr. H. F. Taylor, of Trinity College, continued his investigations of the scales of fishes, (1) concluding as far as possible the investigations of the squeteague scales and (2) verifying and amplifying the results thus attained by similar work on other species.

On account of its adaptability to artificial conditions the pig-fish (*Orthopristis chrysopterus*) was used. Scales of over 80 specimens were examined and the growth rate calculated as for the squeteague. Evidences thus found point to the first year as that of sexual maturity.

While the scales of the pig-fish are much more regular in their features than those of the squeteague, observations of the radii corroborate the evidence obtained in 1912 that the radii are merely fissures to permit greater freedom of body movement.

Dr. H. V. Wilson, of the University of North Carolina, spent the summer in an examination of the collection of Philippine sponges. The collection embraces all the great groups of sponges: *Calcarea, Hexactinellids,* Tetractinellids including *Lithistida, Monaxonida* and *Keratosa.* Sixty-odd packages were examined. These were found to represent twenty-five species, the majority of which are new forms.

Dr. James J. Wolfe, of Trinity College, devoted his investigations primarily to an examination of the Diatomaceæ of Beaufort. Extensive tow-net collections were made at various localities under a variety of conditions. These are to be continued at monthly intervals for one year. By this means it is hoped a thoroughly representative collection will be secured. Mounts have been made of about 200 species and considerable progress has been made in their identification.

The culture of *Padina* sporelings was again carried on—now with special reference to parthenogenesis. Cultures demonstrably parthenogenetic, started in the laboratory, as in the earlier work, were transferred to the sea. Unfortunately these were destroyed by the severe storm of September 3–4, necessitating their repetition before this work can be reported in full.

Mr. Raymond B. Beckwith, of Olivet College, and Mr. Francis Harper, of Cornell University, who were assigned to the director for duty, accompanied the various collecting trips and kept complete records of their observations, devoting special attention to the habits of the fishes of the region.

In addition to his other duties, Mr. Beckwith accompanied the *Fish Hawk* on the various collecting trips and assisted the director on the survey of the off-shore fishing grounds.

In addition to his regular work Mr. Harper took a large series of photographs and a number of autochromes of live flounders to be used in illustrating Dr. Mast's report. He also made numerous observations on the birds of the region. In addition to the incidental observations on field trips for fishes, a few holidays and Sundays were devoted to this work and a list of 87 species recorded. Ten birds were tagged with leg-bands furnished by the American Bird Banding Association. A breeding colony of herons on an island in the vicinity of the laboratory was found on August 9 to contain approximately 350 little blue herons (*Florida cærulæa*), 150 Louisiana herons (*Hydranassa tricolor ruficollis*), 8 black-crowned night herons (*Nycticorax nycticorax nævius*) and 6 American egrets (*Herodias egretta*). The little blue heron is not recorded as a breeding bird of North Carolina in the American Ornithologist's Union List, and this is the first time the American egret is known to have nested in the vicinity since 1899. Tentative arrangements have been made for the protection of the colony next year by a warden of the National Association of Audubon Societies. A number of species of shore birds were studied and photographed during the latter part of the summer.

An artist, Mrs. E. Bennett Decker, of Washington, D. C., was engaged in making the drawings to illustrate the embryological papers of Dr. Kuntz, and a series of drawings of the dermal denticles and teeth of the sharks of the region to accompany the report of the director on this subject.

LEWIS RADCLIFFE

BUREAU OF FISHERIES,
WASHINGTON, D. C.,
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SPECIAL ARTICLES

THE TRANSMISSION OF TERRESTRIAL RADIATION BY THE EARTH'S ATMOSPHERE IN SUMMER AND IN WINTER

AN indirect measurement of the transmission through the earth's atmosphere of those radiations which are emitted by the earth's solid surface may be made by comparing the actual radiation of a surface at the terrestrial temperature toward the sky, with that toward a black body at absolute zero. The latter can